

CLAIMS

What is claimed is:

1. A method of predicting the occurrence an event on a machine or process comprising the steps of:

5 receiving a first set of historical operating data from said machine or process, said first set of historical operating data including at least one occurrence of the significant event to be predicted;

creating a predictive model based on the first set of historical operating data such that when the predictive model is applied to future sets of historical operating data
10 the predictive model will predict whether said significant event will occur within a specified prediction window;

receiving a second set of historical operating data from said machine, said second set of historical operating data covering a data collection period preceding the prediction window;

15 applying the predictive model to the second set of historical operating data to predict whether the significant event will occur during the prediction window.

2. The method of claim 1 further including the steps of:

receiving a third set of historical operating data covering a period of time
20 corresponding to the prediction window;

comparing the times when the significant event occurred during the prediction window with the predicted occurrences of the significant event; and

revising the predictive model based on said comparison to improve the accuracy of future predictions.

3. The method of claim 1 wherein the predictive model is created to determine the time at which the significant event predicted to occur will occur within the prediction window.

4. The method of claim 3 further comprising the steps of collecting additional sets of historical operating data on a predetermined scheduled basis and applying the predictive model to each additional set of historical operating data to predict if and when the significant event will occur during subsequent prediction windows.

5. The method of claim 4 wherein the step of collecting the sets of historical operating data comprises an automatic set transfer of data from the machine over a computer network.

6. The method of claim 4 further comprising the step of conditioning the data contained in said sets of historical operating data to configure the data in a manner that can be operated on by the predictive model.

7. The method of claim 3 further comprising the step of generating a report indicating when the significant event is predicted to occur.

8. A process for predicting the occurrence of one or more machine error codes associated with the operation of one or more machines or processes, the method comprising the steps of:

analyzing historical operating data from said one or more machines or processes

5 to identify significant precursor events associated with the occurrence of each said error code;

developing predictive models for each error code based on the application of one or more statistical tools and pattern recognition techniques whereby future occurrences of said error codes may be predicted within a defined prediction time window from an
10 analysis of the occurrences of said significant precursor events within a data collection time window preceding the prediction time window;

collecting operating data, including the occurrence of said significant precursor events, during the data collection time window; and

applying the predictive models to the data collected to generate predictions of
15 the occurrence of said error codes on said one or more machines or processes within the prediction time window.

9. The process of claim 8 wherein the step of developing a predictive model includes applying entropy based feature selection.

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10. The process of claim 8 wherein the step of developing a predictive model includes applying discriminant analysis.

11. The process of claim 8 wherein the step of developing a predictive model includes applying K-NN classifiers.

12. The process of claim 8 wherein the step of developing a predictive model includes applying hierarchical classifiers.

13. The process of claim 8 wherein the step of developing a predictive model includes applying artificial neural networks.

14. The process of claim 8 wherein the step of developing a predictive model includes applying genetic classification algorithms.

15. The process of claim 8 wherein the step of developing a predictive model includes applying principal component/factor analysis.

16. The process of claim 8 wherein the step of developing a predictive model includes applying an adaptive filter.

17. The process of claim 16 wherein the adaptive filter comprises a Kalman filter.

18. The method of claim 8 further comprising the step of conditioning the operating data collected from the one or more machine or processes, including extracting data

relevant for making said predictions, and formatting the data in a manner compatible with the predictive model.

19. The method of claim 8 wherein the collection time window is approximately
5 equal to the prediction time window.

20. A method of performing predictive maintenance on a machine or process,
comprising the steps of:

receiving historical operating data from the machine or process, said historical
10 operating data including the occurrence of significant operating events; analyzing the
historical operating data to determine whether foreknowledge of the future occurrence
of a significant operating event has value; and

implementing a program for predicting the occurrence of those significant events
for which it has been determined that having foreknowledge of the future occurrence of
15 the event has value within a predefined prediction window based on an historical
operating data set gathered during a data collection window preceding the prediction
window.

21. The method of claim 13 wherein the step of implementing a program comprises:

20 receiving sets of historical operating data from said machine or process on a
regular basis, each set corresponding to a particular data collection window preceding a
corresponding prediction window;

analyzing the data sets to determine whether data within the data sets indicate that an event for which foreknowledge of the future occurrence of the event adds value will occur during the corresponding prediction window.

5 22. The method of claim 14 wherein the step of analyzing the historical operating data sets comprises applying a predictive model for each significant event for which it has been determined that having foreknowledge of the future occurrence of the event has value to the data sets, and generating an event prediction report that indicates which events for which having foreknowledge of their future occurrence adds value will occur
10 during the prediction window.

23. The method of claim 15 wherein the step of applying a predictive model to the data sets comprises applying one or more statistical analysis tools and pattern recognition techniques to the data within the data sets.

15 24. The method of claim 23 wherein the step of developing a predictive model includes applying entropy based feature selection.

25. The process of claim 23 wherein the step of developing a predictive model
20 includes applying discriminant analysis.

26. The process of claim 23 wherein the step of developing a predictive model includes applying K-NN classifiers.

27. The process of claim 23 wherein the step of developing a predictive model includes applying hierarchical classifiers.

5 28. The process of claim 23 wherein the step of developing a predictive model includes applying artificial neural networks.

29. The process of claim 23 wherein the step of developing a predictive model includes applying genetic classification algorithms.

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30. The process of claim 23 wherein the step of developing a predictive model includes applying principal component/factor analysis.

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31. The process of claim 23 wherein the step of developing a predictive model includes applying an adaptive filter.

32. The process of claim 31 wherein the adaptive filter comprises a Kalman filter.